PENDING CLAIMS

2. The apparatus of claim 55 further comprising

a non-imaging optical concentrator, for delivering a beam of light emitted from said optical fiber having half-angle divergence of 90 degrees, located between said optical fiber and said first port.

3. The apparatus of claim 2 further comprising:

a second non-imaging optical concentrator, its high-divergence side coincident with said second port.

4. The apparatus of claim 3,

wherein said second port is adapted to direct light from said optical fiber to a patient, and further comprising:

a second non-imaging optical waveguide having a third port and a fourth port, said second non-imaging waveguide adapted to efficiently direct all the light entering through said fourth port around a second bend;

said fourth port receiving light from the patient,

said third port directing the light received from the patient through said fourth port to a second optical fiber;

a third non-imaging optical concentrator, its low-divergence side coincident with said fourth port; and

a fourth non-imaging optical concentrator, for delivering a beam of light to said second optical fiber, located between said second optical fiber and said third port.

5. The apparatus of claim 2 wherein said non-imaging optical waveguide comprises a curved reflective segment located between said first port and said second port.

6. The apparatus of claim 5 wherein, in any section parallel to the plane of said bend, said curved reflective segment appears as an arc of a circle, wherein the plane of the bend is the plane through which the maximum angle of bend is exposed.

7. The apparatus of claim 5 wherein said curved reflective segment is an inner curve, further comprising a second curved reflective segment as an outer curve, located between said first port and said second port.

8. The apparatus of claim 55,

wherein every section parallel to the plane of said bend is geometrically identical, wherein the plane of the bend is the plane through which the maximum angle of bend is exposed, and upper and lower surfaces of said non-imaging optical waveguide are planar reflective surfaces, wherein said upper and lower surfaces are parallel to said plane and bound said waveguide.

9. The apparatus of claim 6 wherein said arc has a radius of the width of said first port, and a center at an end of said first port at an inside of said turn around said bend.

10. The apparatus of claim 9 wherein said arc extends to said second port at an angle of 60 degrees from a plane of said first port.

11. The apparatus of claim 9 wherein said arc extends to said second port at an angle not exceeding $(90°+\phi)/2$, where ϕ is the maximum half-angular divergence of rays entering said first port.

12. The apparatus of claim 55, further comprising

a non-imaging optical concentrator for delivering a beam of light having half-angle divergence of 90 degrees, located between said optical fiber and said first port; and

wherein said non-imaging optical waveguide comprises a first curved reflective segment extending along an outside of a turn around of said bend, and a second curved reflective segment extending around an inside of said turn around said bend.

13. The apparatus of claim 12 wherein, in any section parallel to the plane of said bend, said first curved reflective segment appears as a section of a first ellipse and said second curved reflective segment appears as a section of a second ellipse, wherein the plane of the bend is the plane through which the maximum angle of bend is exposed.

14. The apparatus of claim 13 wherein

said first ellipse has foci at ends of said second curved reflective segment; and

said second ellipse has foci at ends of said first curved reflective segment.

15. The apparatus of claim 14 wherein

every section parallel to the plane of said bend is geometrically identical, wherein the plane of the bend is the plane through which the maximum angle of the bend is exposed, and

upper and lower surfaces of said non-imaging optical waveguide are planar reflective surfaces, wherein said upper and lower surfaces are parallel to said plane and bound said waveguide.

16. The apparatus of claim 14 wherein:

said non-imaging optical concentrator is of the 3D type, and

in every section parallel to the plane of said bend, said first curved reflective segment is of such size as to contact the outer edge of said first port and said second curved reflective surface is of such size as to contact the inner edge of said first port, wherein the plane of the bend is the plane through which the maximum angle of the bend is exposed.

17. The apparatus of claim 55,

wherein said non-imaging optical waveguide comprises:

a first reflective segment extending along an inside of a turn around said bend from said first port to said second port, such that in any section parallel to the plane of said bend, said first reflective segment appears as a straight line; and

a second reflective segment extending along an outside of said turn around said bend from said first port to said second port, such that in any section parallel to the plane of said bend, said second reflective segment appears as a curve comprising

a first parabolic segment extending from said first port,

an elliptical segment extending from said first parabolic segment, and

a second parabolic segment extending from said elliptical segment to said second port, wherein the plane of the bend is the plane through which the maximum angle of the bend is exposed.

18. The apparatus of claim 17 wherein:

every section parallel to the plane of said bend is geometrically identical, and

upper and lower surfaces of said non-imaging optical waveguide are planar reflective surfaces, wherein said upper and lower surfaces are parallel to said plane and bound said waveguide.

19. The apparatus of claim 17 wherein:

said first port is circular in cross section, and

in every section parallel to the plane of said bend, said first curved reflective segment is of such size as to contact the outer edge of said first port and said second curved reflective surface is of such size as to contact the inner edge of said first port.

20. The apparatus of claim 17 wherein said elliptical segment is so constructed that the slope of said elliptical segment is equal to slopes of said first and second parabolic segments at their respective points of intersection.

21. The apparatus of claim 17 wherein said elliptical segment has foci at the ends of said first reflective segment.

22. The apparatus of claim 17 wherein said first parabolic segment has a focus at an intersection of said planar reflective segment and said second port.

23. The apparatus of claim 17 wherein said second parabolic segment has a focus at an intersection of said first reflective segment and said first port.

24. The apparatus of claim 17, wherein said second port is at an angle of less than ninety degrees from said first port, and further comprising:

a third port around a second bend from said second port;

a third reflective segment extending along an inside of a turn around said second bend from said second port to said third port, such that in any section parallel to the plane of said bend, said third reflective segment appears as a straight line;

a fourth reflective segment extending along an outside of said turn around said second bend from said second port to said third port, such that in any section parallel to the plane of said bend, said fourth reflective segment appears as a curve comprising:

a third parabolic segment extending from said second port,

a second elliptical segment extending from said third parabolic segment, and

a fourth parabolic segment extending from said second elliptical segment to said third port.

25. The apparatus of claim 55,
wherein said first and second ports are rectangular.

26. The apparatus of claim 55,
wherein said first and second ports are circular.

51. The apparatus of claim 2 wherein said non-imaging optical concentrator is a compound parabolic concentrator.

52. The apparatus of claim 12 wherein said non-imaging optical concentrator is a compound parabolic concentrator.

53. The apparatus of claim 16 wherein said non-imaging optical concentrator is a compound parabolic concentrator.

54. The apparatus of claim 3 wherein said second non-imaging optical concentrator is a compound parabolic concentrator.

55. An apparatus for efficiently deflecting light from an optical fiber around a bend, comprising:

a non-imaging optical waveguide, said waveguide being bound by and having a first port and a second port, said non-imaging waveguide adapted to efficiently direct all the light entering through said first port around said bend;

said first port receiving light having divergence angles of less than 90 degrees as measured relative the central axis of said optical fiber, said central axis of said optical fiber being perpendicular to said first port;

said second port emitting light having divergence angles as large as 90 degrees relative to the central axis of said second port, said central axis of said second port being perpendicular to said second port.